CLAIMS

We Claim:

1. A method of producing sheets of glass having two faces (F_1, F_2) with at least one of said faces (F_1) presenting a high surface quality, the method comprising:

a) delivering a stream of glass (1a), said stream of glass (1a) having a first and second face (s_1, s_2), each face is free from making contact with any surface and thus possibly being destabilized mechanically;

b) treating said delivered stream of glass (1a) prior to destabilization by putting a first face (s_2) into contact with a treatment device or mechanism (4a) suitable, temporarily, to support the weight of said glass and for accompanying the falling movement of said glass while increasing glass viscosity and maintaining at least a central strip of said second face (s_1) free from any contact with any surface;

c) using a device or mechanism for controlling glass travel speed (7, 8) to act on the treated stream (1a') at a suitable distance downstream; and

d) cooling said sheet of glass.

2. The method according to claim 1, wherein said method further comprises: guiding said treated stream of glass (1a') towards said device or mechanism (7, 8); said guidance being provided while ensuring that at least said central strip of said second face (s_1) of said treated stream of glass (1'a) continues to be kept free from contact with any surface.

3. The method according to claim 1 wherein said device or mechanism for controlling glass travel speed also controls the width and the thickness of the sheet of glass produced.

4. The method according to claim 1, wherein said stream of glass (1a) is delivered with a viscosity in the range of about 5 Pa.s to about 5000 Pa.s (50 poises to 50,000 poises).

5. The method according to claim 1, wherein said stream of glass is delivered with a viscosity in the range of about 10 Pa.s to about 1000 Pa.s (100 poises to 10,000 poises).

6. The method according to claim 1, wherein said delivered stream of glass (1a) remains free from any contact with any surface whatsoever over a height that does not exceed 150 mm.

7. The method according to claim 6, wherein said delivered stream of glass (1a) remains free from any contact with any surface with a height less than 60 mm.

8. The method according to claim 1, wherein said treatment of said delivered stream (1a) comprises:

a) receiving said delivered stream of glass (1a) on the surface of a roller (4a), said roller (4a) presenting a suitable surface temperature and being set into rotation in a suitable direction and at a suitable speed to accompany the movement of said stream (1a) without any relative displacement of said stream (1a) relative to the surface of said roller (4a);

b) maintaining contact between the stream (1a) and the roller (4a) without relative displacement over a significant fraction of the circumference of said roller (4a);

wherein said roller (4a) being associated with device or mechanism (9a) for controlling its surface temperature and thus the temperature of the glass in contact therewith, said roller (4a) being disposed and driven appropriately to ensure that said contact that is maintained cools the glass sufficiently to obtain the desired increase in viscosity.

9. The method according to either claim 1 or 8, characterized in that said treated stream (1a') at the end of said treatment presents a viscosity in the range of about 10^3 Pa.s to about 10^6 Pa.s (10^4 poises to 10^7 poises).

10. The method according to claim 3, wherein said guidance of said treated stream of glass (1a') is implemented under temperature control.

11. The method according to claim 2, wherein said treated stream of glass (1a') is guided on a film of gas, and advantageously between two films of gas.

12. The method according to claim 2, wherein margin rollers or wheels (17a, 17b) guide said treated stream of glass (1a').

13. The method according to claim 12, wherein pairs of said rollers or wheels (17a, 18a; 17b, 18b face each other on opposite sides of said treated stream of glass (1a').

14. The method according to any one of claims 1, wherein said method further comprises:

a) delivering a second stream of glass (1b; 1c; 1d; 1e) compatible with the first stream of glass (1a); said second stream of glass (1b; 1c; 1d; 1e) having a first and second face (s_1, s_2), both of said faces being free from contact with any surface, thus possibly being destabilized mechanically;

b) treating said second delivered stream of glass (1b; 1c; 1d; 1e) prior to destabilization in order to stabilize it mechanically and increase its viscosity;

c) guiding the first and second treated streams of glass (1a'; 1b', 1c', 1d', 1e') towards a junction zone; said guidance of said first treated stream (1a') being provided while ensuring that at least the central strip of said second face (s_1) of said first treated stream of glass (1a') that has been kept free from making contact with any surface continues to be kept free from any such contact;

d) joining said first and second treated and guided streams (1a'; 1b', 1c', 1d', 1e'); the streams being joined via the first face (s_2) of said first treated stream of glass (1a') that has come into contact upstream with said treatment device or mechanism (4a), while said second face (s_1) of said first treated stream of glass (1a') remains relatively free from any contact with any surface whatsoever; and wherein an action of said device or mechanism (7, 8) suitable for controlling the travel speed and the width and the thickness of the sheet of glass is applied to said two joined-together streams of glass (1a'+1b'; 1a'+1c'; 1a'+1d'; 1a'+1e').

15. The method according to claim 14, wherein said treatment of said second delivered stream of glass (1c) includes rolling or laminating, implemented with or without transferring an imprint.

16. The method according to claim 15, wherein an imprint is transferred.

17. The method according to claim 14, wherein said method comprises:

- delivering two compatible streams of glass (1a, 1b, or 1e); said two delivered streams of glass (1a, 1b, or 1e) each having both faces (s_1, s_2) free from any contact with any surface whatsoever and thus being liable to be destabilized mechanically;

- independently treating said two delivered streams of glass (1a, 1b, or 1e) prior to destabilization, by putting a first face (s_2) in contact with said treatment device or mechanism (4a, 4b) suitable, temporarily, for supporting the weight of said glass streams and accompanying the falling movement of said glass streams , while increasing the respective viscosities of said glass streams and maintaining at least the central strip of the second face (s_1) free from contact with any surface whatsoever;

- guiding both of said two treated streams of glass (1a', 1b', or 1e') towards a junction zone; said guidance being provided while ensuring that at least the central strip of the second face (s_1) of each of said two treated streams of glass (1a', 1b', or 1e') is kept free from contact with any surface whatsoever continues to be kept free from any such contact;

- joining together said two treated streams of glass (1a', 1b', or 1e') via their first faces (s_2) that have come into contact with said treatment device or mechanism (4a, 4b) upstream; the second face (s_1) remaining relatively free from any contact with any surface whatsoever;

- acting on said two joined-together treated streams (1a'+1b' or 1e') with device or mechanism (7, 8) suitable for controlling the travel speed, width, and thickness of the sheet of glass; and

- cooling said sheet of glass.

18. The method according to claim 16, characterized in that it also comprises:

- transferring an imprint onto one (1e') of said two treated streams of glass (1a', 1e') prior to joining together said two treated streams (1a', 1e').

19. The method according to claim 14, characterized in that it comprises:

- delivering two compatible streams of glass (1a, 1d); said two delivered streams of glass (1a, 1d) each having a first and a second face (s_1, s_2) free from any contact with any surface whatsoever and thus being liable to be destabilized mechanically;

- treating both of said delivered streams (1a, 1d) independently prior to destabilization: a first stream (1a) of said two streams of glass (1a, 1b) being treated by putting a first face (s_2) of its two faces (s_1, s_2) into contact with treatment device or mechanism (4a) suitable for temporarily supporting its weight and for accompanying its falling movement while increasing its viscosity and while maintaining at least the central strip of the second face (s_1) free from contact with any surface whatsoever; while,

the second stream (1d) of said two streams (1a, 1d) is treated by putting a first (s_2) of its two faces (s_1, s_2) into contact with a treatment device or mechanism (4d) suitable, temporarily, for supporting the weight of said glass stream and for accompanying the falling movement of said glass stream, while increasing viscosity of the glass stream and while subjecting the second face (s_1) of its two faces (s_1, s_2) to an action of other device or mechanism (4c) which, co-operating with said treatment device or mechanism (4b), serves to transfer an imprint onto said second face (s_1);

- guiding both of the two treated streams of glass (1a', 1d') towards a junction zone; said guidance being provided while ensuring that at least the central strip of the second face (s_1) of the first treated stream of glass (1a') continues to be kept free from any such contact, and while ensuring that at least the central strip of the second face (s_1) of the second treated stream of glass (1d') onto which an imprint has been transferred is also not put into contact with any surface whatsoever;

- joining said two treated streams of glass (1a', 1d') together via their respective first faces (s_2) which have come into contact with said treatment device or mechanism (4a, 4b) upstream; at least the second face (s_1) of the first treated stream (1a') which

does not have an imprint remaining relatively free from any contact with any surface whatsoever;

- acting on said joined-together treated streams of glass (1a'+1d') by device or mechanism (7, 8) suitable for controlling the travel speed, width, and thickness of said sheet of glass that is produced; and

- cooling said sheet of glass.

20. The method according claim 14, wherein said two sheets of glass (1a, 1b; 1a, 1c; 1a, 1d; 1a, 1e) are delivered either from a single source (2; 20) or from two distinct sources (200, 200; 200, 2000).

21. An apparatus for producing sheets of glass having two faces (F_1, F_2), at least one of said faces (F_1) presents a high-surface quality, the apparatus, from upstream to downstream, comprises:

- a deliverer (2; 20; 200) for delivering a stream of glass (1a) under conditions in which said stream of glass (1a) has both of its two faces (s_1, s_2) free from any contact with any surface whatsoever;

- a treatment device (4a) for treating said delivered stream of glass (1a), said device or mechanism (4a) being suitable for being put into contact with one (s_2) of its two faces (s_1, s_2) and for supporting the weight of said stream (1a) temporarily while accompanying its falling movement and increasing its viscosity and while maintaining at least the central strip of the other one (s_1) of its two faces (s_1, s_2) free from any contact with any surface whatsoever;

the relative disposition of said delivery device or mechanism (2; 20; 200) and said treatment device or mechanism (4a) being compatible with the mechanical stability of said delivered stream (1a);

- a controller (7, 8) located at a suitable position downstream for controlling the travel speed, width, and thickness of the resultant sheet of glass; and

- a cooler for cooling said sheet of glass that is produced.

22. The apparatus according to claim 21, wherein said apparatus further comprises:

- a guider (5; 17a, 18a) for guiding said treated stream (1a'); said guider (5; 17a, 18a) acting upstream from said contoller (7, 8) for controlling the travel speed, width, and thickness of the sheet of glass and performing its guidance function without involving any contact with at least the central strip of a face (s_1) of the treated stream of glass (1a') that has been kept free from any contact with any surface whatsoever by said treatment device (4a).

23. The apparatus according to claim 21, wherein the relative disposition of the deliverer (2; 20; 200) and of the treatment device (4a) is such that the delivered stream of glass (1a) remains free from any contact with any surface whatsoever over a height that does not exceed 150 mm.

24. The apparatus according to claim 23, wherein the relative disposition of the deliverer (2; 20; 200) and of the treatment device (4a) is such that the delivered stream of glass (1a) remains free from any contact with any surface whatsoever, of a height less than 60 mm.

25. The apparatus according to claim 21, wherein said treatment device (4a) for treating said delivered stream of glass (1a) comprises a roller (4a) suitable for being driven in rotation and associated with said controller for controlling surface temperature of glass stream.

26. The apparatus according to claim 25, wherein said treatment device being fitted internally with said controller (9a).

27. The apparatus according claim 21, wherein said guider comprises walls (5) along which a film of gas can be generated.

28. The apparatus according to any one of claims 20 to 23, characterized in that said guidance device or mechanism comprise margin rollers or wheels (17a, 17b) and advantageously pairs of such rollers or wheels (17a, 18a; 17b, 18b); the rollers or

wheels of each of said pairs being arranged facing each other on opposite sides of the path along which the treated stream of glass (1a') flows.

29. The apparatus according to any one of claims 20 to 23, characterized in that said guidance device or mechanism (5) are suitable for controlling the temperature of the treated and guided stream (1a').

30. The apparatus according to any one of claims 19 to 29, characterized in that said device or mechanism for controlling the travel speed and also the width and the thickness of the sheet of glass that is produced comprise margin wheels (7) and/or tractor rollers (8), advantageously margin wheels (7) followed by tractor rollers (8) further downstream.

31. The apparatus according to any one of claims 20 to 30, characterized in that it further comprises:

- delivery device or mechanism (2; 20; 200; 2000) for delivering a second stream of glass (1b; 1c; 1d; 1e) under conditions in which said second stream of glass (1b; 1c; 1d; 1e) has both of its two faces (s_1, s_2) free from any contact with any surface whatsoever;
- treatment device or mechanism (4b; 4b+4c) for treating said second delivered stream of glass (1b; 1c; 1d; 1e), the treatment device or mechanism (4b; 4b+4c) being suitable for mechanically stabilizing said second delivered stream (1b; 1c; 1d; 1e) and for increasing its viscosity;

the relative disposition of said delivery device or mechanism (2; 20; 200; 2000) and said treatment device or mechanism (4b; 4b+4c) being compatible with mechanical stability of said second delivered stream (1b; 1c; 1d; 1e);

- guidance device or mechanism (5; 17b, 18b) for guiding said second treated stream of glass (1b'; 1c'; 1d'; 1e') towards a junction zone for joining it (1b'; 1c'; 1d'; 1e') with a first treated and guided stream of glass (1a');
- junction device or mechanism (5; 19) for putting said first and second treated and guided streams (1a', 1b'; 1a', 1c'; 1a', 1d'; 1a', 1e') into contact; said first treated stream (1a') being put into contact with said second treated stream (1b'; 1c'; 1d'; 1e') via

its face (s_2) that has come into contact upstream with the treatment device or mechanism (4a), its other face (s_1) remaining (quasi) free from any contact with any surface whosoever; and

in that the device or mechanism (7; 8) disposed at a suitable position downstream from the junction zone are suitable for controlling the travel speed and also the width and the thickness of the sheet of glass that is produced by joining together said first and second treated streams (1a'; 1b'; 1c'; 1d'; 1e').

32. The apparatus according to claim 31, characterized in that said device or mechanism for treating said second delivered stream of glass (1c) comprise a rolling (laminating) device (4b+4c), advantageously suitable for transferring an imprint to the glass.

33. The apparatus according to claim 31, characterized in that it comprises, from upstream to downstream:

- delivery device or mechanism (2; 20; 200) for delivering two streams of glass (1a, 1b, or 1e) under conditions in which each of them has both of its faces (s_1, s_2) free from any contact with any surface whatsoever;

- treatment device or mechanism (4a, 4b) for independently treating each of said delivered streams of glass (1a, 1b, or 1e), which treatment device or mechanism (4a, 4b) are suitable for being put into contact with one of the two faces (s_2) of each of said two streams (1a, 1b, or 1e) and for supporting the weight of each of said streams (1a, 1b, or 1e) temporarily, for accompanying the falling movement of each of said streams (1a, 1b, or 1e) while increasing the respective viscosities of each of said two streams (1a, 1b, or 1e) and while maintaining at least the central strip of the other one (s_1) of the two faces of each of said streams (1a, 1b, or 1e) free from any contact with any surface whatsoever;

- the relative disposition of each delivery device or mechanism (2; 20; 200) and of said treatment device or mechanism (4a, 4b) being compatible with mechanical stability of said delivered streams (1a, 1b, or 1e);

- guidance device or mechanism (5; 17a, 17b) for guiding both of said treated streams (1a', 1b', or 1e') towards a junction zone; said guidance device or mechanism

(5; 17a, 17b) performing their function without involving any contact with at least the central strip of the face (s_1) of each of said treated streams (1a', 1b', or 1e') that have been kept free from any contact with any surface whatsoever by the treatment device or mechanism (4a, 4b);

- junction device or mechanism (5; 19) for putting said two treated streams (1a', 1b', or 1e') into contact via their faces (s_2) that have come into contact with the treatment device or mechanism (4a, 4b); their other faces (s_1) remaining (quasi) free from any contact with any surface whatsoever;

- device or mechanism (7, 8) for controlling the travel speed and also the width and the thickness of the sheet of glass that is produced; and

- device or mechanism for cooling said sheet of glass that is produced.

34. The apparatus according to claim 33, characterized in that it further comprises:

- device or mechanism (4c+4c') for transferring an imprint onto one (1e') of said two treated streams (1a', 1e'), said device or mechanism being disposed upstream from the junction device or mechanism (19) for joining together said two treated streams (1a', 1e').

35. The apparatus according to claim 31, characterized in that it comprises:

- delivery device or mechanism (2) for delivering two streams (1a, 1d) of compatible glass under conditions in which each of said streams of glass (1a, 1d) has both of its faces (s_1, s_2) free from any contact with any surface whatsoever;

- treatment device or mechanism for independently treating each of said two delivered streams of glass (1a, 1d): said treatment device or mechanism comprising first device or mechanism (4a) suitable for being put into contact with one (s_2) of the two faces (s_1, s_2) of one (1a) of said two streams (1a, 1d) and for supporting the weight of said stream (1a) temporarily, accompanying its falling movement while increasing its viscosity and maintaining at least the central strip of the other one (s_1) of said two faces (s_1, s_2) of said stream (1a) free from any contact with any surface whatsoever; and second device or mechanism (4b) suitable for being put into contact with one (s_2) of the two faces (s_1, s_2) of the other one (1d) of said two delivered streams (1a, 1d) and for supporting the weight of said stream (1d) temporarily, accompanying its falling

movement while increasing its viscosity, and also third device or mechanism (4c) suitable for co-operating with said second device or mechanism (4b) for transferring an imprint onto the other one (s_1) of the two faces (s_1, s_2) of the other one (1d) of said two delivered streams (1a, 1d);

the relative disposition of said delivery device or mechanism (2) and said treatment device or mechanism (4a, 4b+4c) being compatible with mechanical stability of said delivered streams (1a, 1d);

- guidance device or mechanism (5) for guiding each of said two treated streams (1a', 1d') towards a junction zone; said guidance device or mechanism (5) performing their action without involving any contact with at least the central strip of the face (s_1) of the treated stream (1a') that has been kept free from any contact with any surface whatsoever by the device or mechanism (4a) involved in its treatment, and also, advantageously, without involving any contact by any surface whatsoever with at least the central strip of the face (s_1) of the other treated stream (1d') on which said third device or mechanism (4c) have acted in contact;

- junction device or mechanism (5) for putting said two treated streams (1a', 1d') into contact via their faces (s_2) that have been put into contact, upstream, respectively with the first and second treatment device or mechanism (4a, 4b); said junction device or mechanism (5) ensuring that at least the other face (s_1) of the treated stream (1a') which does not carry an imprint remains (quasi) free from any contact with any surface whosoever;

- device or mechanism (7, 8) for controlling the travel speed and also the width and the thickness of the sheet of glass that is produced; and

- device or mechanism for cooling said sheet of glass that is produced.

36. The apparatus according to any one of claims 31 to 35, characterized in that said delivery device or mechanism (200; 2; 20; 2000) for delivering said two streams of glass (1a, 1b; 1a, 1c; 1a, 1d; 1a, 1e) are constituted by a single glass feed source (2; 20) or by two distinct sources of glass (200, 2000).

37. The apparatus according to any one of claims 31 to 36, characterized in that said delivery device or mechanism (200; 2; 20) for delivering said two streams of glass are selected from:

- a receptacle (2) suitable for being fed and for overflowing over two of its faces;
- a casting device (20) having two distinct open ends fitted with slots; and
- two isopipes (200).